TECHNICAL MANUAL

MODEL 4017C1

POWER MEASURING SET

GENERAL MICROWAVE CORPORATION

TECHNICAL MANUAL

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POWER MEASURING SET

IMPORTANT

This preliminary material has been prepared to permit earliest possible delivery of the equipment. To ensure that the final literature reaches the proper person, PLEASE COMPLETE AND RETURN THIS CARD. The final manual cannot be shipped until this card is returned.

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1.0 GENERAL

This Technical Manual consists of the following in addition to this document:

Operating and Service Data for GMC Model 476 Thermoelectric Power Meter

Operating Instructions for Model N4240A Coaxial tft Power Head

Tech Data for Model 4017C1 Power Measuring Set

GMC drawing 8557

2.0 INTRODUCTION

The Model 4017C1 consists of a Model 476 Power Meter, a Model N4240A tft Power Head, a set of four precision attenuators, and a carrying case.

3.0 OPERATION

Operation of the Model 4017C1 is identical to that described in the attached power meter literature. To increase the maximum power level measuring capability beyond 10 mW, connect one or more of the precision attenuators furnished with the Model 4017C1 to the input of the Model N4240A. (Be sure to add the total value of attenuation connected to the Model N4240A to the Model 476 indication.)

FUNCTIONAL DESCRIPTION

The 4017C1 is a portable power measuring set, consisting of a thermoelectric power meter, coaxial power head, precision attenuator set, and carrying case. The power meter, in conjunction with the coaxial power head,measures modulated, pulsed, and CW signals at average rf power levels from 0.03 uW to 10 mW, over the frequency range from 0.01 to 18 GHz. The attenuator set operates over the frequency range from DC to 18 GHz and extends the power measuring range of the 4017C1 test set to 1 watt.

Option 03 adds an 18.0 to 26.5 GHz waveguide power head and Option 04, a 26.5 to 40.0 GHz waveguide head. Both operate with the power meter to measure average power levels from 0.03 uW to 10 mW.

Option 05 adds both the Option 03 and Option 04 power heads to the test set.

The power meter has ten ranges, selected by means of a front-panel rotary switch. Its front panel analog meter offers two linear power scales, 0 to 10 and 0 to 3, and one 0 to -10 dB scale. All scales are direct reading. A front-panel zero setting push-button is used to set zero on any power range. All others are automatically zero set simultaneously. A rear-panel output connector is provided for measurement systems using external recorders or digital voltmeters. The voltage output, when connected to a load impedance of 1000 ohms or more, is a DC analog of the measured RF power. A 10 kHz oscillator is contained which enables calibration of the power meter and the power head without disconnecting the power head from the rf system under measurement.

The power heads interface directly with the input connector on the power meter front panel. Each power head is calibrated against NBS-certified standards and a graph of the calibration factor versus frequency is permanently mounted on the power head housing. A front-panel control on the power meter compensates for the power head calibration factor. The power heads also feature 300% overload protection, and field replaceable thermoelectric elements.

A carrying case houses all component parts of this equipment in shock resistant form-fitting inserts.

Specifications and prices subject to change without notice.
Litho in U.S.A.

TECHNICAL (ELECTRICAL AND MECHANICAL) CHARACTERISTICS

POWER METER

Frequency Range: 0.01-40 GHz, depending on power head with which it is used

Average Power Range: 0.03 to 10 mW (direct); to 1 watt with coaxial attenuator set

Accuracy: ±1% of full scale on all ranges from 0 degree to +55 degrees C

Noise and Drift: Less than 1.5 % peak on most sensitive range; proportionately less on less sensitive ranges

Self Calibration: Internal 10 kHz oscillator

Calibration Oscillator Accuracy: ±0.3% at +25°C

Zero Set: Automatic on all ranges, operated by front-panel button

Rf Disable: Provides ground closure at rear connector in auto-zero and calibration modes

Scale Selection: Automatic indicator corresponding to power head in use

Power Head Calibration Factor Compensator: Continously variable front-panel control with range from 86 to 100%

Response Time (Time Constant): Less than 0.5 second for seven upper ranges; less than 1.5 seconds for three most sensitive ranges

Recorder Output: Rear mounted connector provides output proportional to indicated power; minimum load resistance of 1000 ohms

Meter: 4.5 inches, mirror-backed scale, taut band suspension

Input Power: 115 V ±10%, single phase AC, at 50 Hz ±5%, 60 Hz ±5%, and 400 Hz ±5%

Input Connector: Front panel mounted

COAXIAL POWER HEAD

Rf Input: N male, 50 ohms

Frequency Range: 10 MHz to 18 GHz

Power Range: 0.03 uW to 10 mW (direct); to 1 W (with attenuator)

VSWR: 1.5 from 0.010 to 0.015 GHz
1.35 from 0.015 to 10 GHz
1.6 from 10 to 18 GHz

Peak Power: 1 W (direct), for pulse duration of 5 usec or less (maximum pulse energy of 5 W-usec); 500 W (with attenuator), at 0 to +25°C

Temperature Coefficient: 0.1%/°C

OPTION 03 WAVEGUIDE POWER HEAD

Rf Input:

Waveguide type: RG-53/U
Flange type: UG-595/U

Frequency Range: 18 to 26.5 GHz

Power Range: 0.03 uW to 10 mW

VSWR: 1.5 max.

Peak Power: 1 W for pulse duration of 5 usec or less (maximum pulse energy of 5 W-usec)

Temperature Coefficient: 0.1%/°C max.

OPTION 04 WAVEGUIDE POWER HEAD

Rf Input:

Waveguide type: RG-96/U
Flange type: UG-599/U

Frequency Range: 26.5 to 40 GHz

Power Range: 0.03 uW to 10 mW

VSWR: 1.65 max.

Peak Power: 1 W for pulse duration of 5 usec or less (maximum pulse energy of 5 W-usec)

Temperature Coefficient: 0.1%/°C

RELATION TO OTHER EQUIPMENT: None

EQUIPMENT REQUIRED BUT NOT SUPPLIED: None

MAJOR COMPONENTS

QTY	ITEM	DIMENSIONS (Inches)	WEIGHT (Lbs.)
	Power Measuring Set, 4017C1, includes:		
1	Thermoelectric Power Meter, 476	6.1H x 5.125W x 11D	7
1	Power Head, N4240A	2.66L x 1.29 dia plus umbilical five foot interconnecting cable	3 oz.
1	Precision Attenuator Set (DC-18 GHz) 3 ± 0.3 dB 6 ± 0.3 dB 10 ± 0.5 dB 20 ± 0.7 dB	2.5L x 0.81 dia (each)	0.5 oz. (each)
1	Option 03 Power Head, K4240C	3.73 L x 2.12 dia plus umbilical five foot interconnecting cable	32 oz.
1	Option 04 Power Head, A4240C	3.73 L x 2.2 dia plus umbilical five foot interconnecting cable	32 oz.
	Option 05 consists of 1 each Option 03 and Option 04 power heads as described above		
1	Carrying Case	10.75 x 15.75 x 20.25	15

INTERIM

OPERATING AND SERVICE DATA

FOR

GMC MODEL 476

THERMOELECTRIC POWER METER

GENERAL MICROWAVE CORPORATION

155 MARINE STREET

FARMINGDALE, NEW YORK 11735

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NOTE

The Model 476 is a third-generation instrument that is the latest addition to General Microwave's thermoelectric power meter line.

The well-established thermoelectric technique of rf and microwave power measurement utilizes a thin-film metallic load in the power head to absorb the incident rf power. The load acts as a true square-law (rms) device, and produces a dc output voltage directly proportional to the absorbed rf power. This dc voltage is applied to the Model 476, which is basically a chopper-stabilized dc amplifier with very low noise, high gain stability and a self-contained voltmeter to indicate its output signal.

This interim technical has been prepared to permit earliest possible delivery of the first production units. Please execute and return the post card bound under the front cover to ensure that the final technical manual reaches the proper person.

SECTION I

GENERAL

1.1 DESCRIPTION

1.2 The GMC Model 476 Thermoelectric Power Meter, in conjunction with the GMC 4200 Series of Coaxial and Waveguide tft[R]* Power Heads, is a highly accurate instrument which measures rf power over an extremely wide frequency and power range. It measures and indicates the average power absorbed by the tft power head in use. (Since the tft element within the power head responds only to the rms value of the input signal, it is completely insensitive to wave shape. Pulsed, amplitude-modulated and cw signals are measured with equal accuracy.) Table 1.1 lists tft power head characteristics.

1.3 The Model 476 features a self-calibration capability employing an internal highly stable 10 kHz oscillator. This circuit ensures that the power meter gain is precisely matched to the sensitivity of the individual tft power head in use. Calibration is conveniently checked and adjusted at the Model 476 front panel without disconnecting the power head from the rf system under measurement.

*thin-film thermoelectric

1.4 The Model 476 also features fully automatic scale selection, which ensures that only the scale corresponding to the dynamic range of the tft power head in use is activated,and automatic zero setting, which can be activated on any range by means of a front-panel push-button. Other features include an output jack for measurement systems using external recorders or digital voltmeters, and an rf disable ground closure at a rear connector in the auto-zero and calibration modes.

1.5 The Model 476 is suitable for use in a wide variety of applications, including portable and field use (when used with the optional Model 981-1 Rechargeable Battery Pack), fixed stations and laboratory bench setups.

1.6 Refer to table 1.2 for additional data.

TABLE 1.2

MODEL 476 SPECIFICATIONS

DYNAMIC RANGE

	MICROWATTS						MILLIWATTS					
FULL-SCALE RANGE	0.3	1.0	3.0	10	30	100	0.3	1.0	3.0	10	30	100
dBm	-35	-30	-25	-20	-15	-10	-5	0	+5	+10	+15	+20
	← Type 4240 Heads →											
	← Type 4241 Heads →											

ACCURACY	±1% of full scale on all ranges from 0°C to +55°C.
NOISE AND DRIFT	Less than 1.5% peak on most sensitive range; proportionately less on less sensitive ranges.
SELF CALIBRATION	Self contained 10 kHz oscillator.
10 kHz OSCILLATOR ACCURACY	±0.3% at +25°C.
ZERO SET	Automatic on all ranges, operated by front-panel button.
RF DISABLE	Provides ground closure at rear connector in auto-zero and calibration modes.
SCALE SELECTION	Automatic indicator corresponding to power head in use.
POWER HEAD CALIBRATION FACTOR COMPENSATOR	Continuously variable front-panel control; range is 86 to 100%.
RESPONSE TIME (TIME CONSTANT)	Less than 0.5 second for seven upper ranges; less than 1.5 seconds for three most sensitive ranges.

DVM/RECORDER OUTPUT	Rear mounted connector provides output proportional to indicated power; minimum load resistance of 1000 ohms.
INPUT POWER	115/230V ±10%, 50-1000 Hz, 5 watts
INPUT CONNECTOR	Front panel mounted.
NOMINAL DIMENSIONS	6.1" H x 5.1" W x 11.3" D (155 x 130 x 289 mm)
APPROXIMATE WEIGHT	7 lbs. (3.2 kg)

ACCESSORY AVAILABLE

Model 981-1 Rechargeable Battery Pack

OPTION AVAILABLE

Option 01. Input connector re-positioned to the rear.

SECTION II

OPERATION

2.1 OPERATING CONTROLS, INDICATORS AND CONNECTORS

The Model 476 operating controls, indicators and connectors are located on both the front and rear panels. Those on the front panel, in addition to the automatic presentation of the power reading, are:

RANGE: A 10-position rotary switch which permits selection of the desired operating power range.

+10 dBm/+20 dBm: The scale corresponding to the sensitivity of the tft power head in use is indicated by means of these two lamps located directly above the RANGE switch. The indicated power level should not be exceeded. See power head literature for additional details.

OPR-CAL: In the CAL position, this switch permits calibration of the tft power head in use by means of the associated screwdriver adjustment.

ZERO: This button is used to electrically zero the Model 476. Once used, it need not be used again when changing ranges.

Power: A three-position switch which energizes the Model 476 using either ac line power or optional battery power. It also permits the battery condition to be checked.

CAL FACTOR: This control permits automatic compensation for the calibration factor of the tft power head in use. The range is 86 to 100%.

The controls and connectors located at the rear of the Model 476 are:

115/230V: This switch permits the application of either 115 volt or 230 volt ac power. If replacement of the associated fuse becomes necessary, ensure that the replacement conforms with the description given in the Table of Replaceable Parts.

OUTPUT: These binding posts provide a calibrated analog voltage of the measured rf power with -0.3 and -1.0 volt corresponding to full scale on the "3" and "10" ranges, respectively. The minimum load resistance is 1000 ohms.

RF BLANKING: A return to ground is provided at this connector in the auto-zero and calibration modes as an aid to the operator whose rf power source can be relay-controlled to be turned off.

2.2 INSTALLATION AND OPERATING PROCEDURES

With the exception of those indicated below, there are no special precautions to be observed when installing or using a Model 476 and tft power heads other than the normal good practices associated with accurate measurement procedures, and the use and handling of microwave components. In these respects, it is suggested that a warm-up period of about 15 minutes be allowed before use to permit circuit stabilization. The flange or connector of the tft power head should be handled with care to avoid scratching or marring the surfaces and connecting parts, and should be covered with a protective cap when not in use to prevent accumulations that can affect performance. Finally, the power ratings of the tft power heads should not be exceeded since permanent damage to the tft element may result. Although the power ratings are conservatively applied, the margin of safety should not be deliberately narrowed.

If it is desired to use a recorder to obtain a plot of power output versus time, use the OUTPUT binding posts. Refer to paragraph 2.1 for additional details.

To operate a Model 476, proceed as follows:

2.2.1 If ac line power is to be used, set the 115V-230V switch as required, make the connection to the ac power source, and set the power switch to ON. Note that beat notes will arise between certain line frequencies and harmonics of the chopper frequency, producing erratic performance of the Model 476. The forbidden line frequency bands are 53-57, 104-116, 162-168, 217-223, 272-278, 327-333, 382-388, 437-443, 492-498, 547-553, 602-608, 657-663, 712-718, 767-773, 822-828, 877-883, 932-938 and 987-993 Hz.

If the optional battery power is to be used, check that the condition of the battery is satisfactory by setting the Power switch to BAT CHK and verifying that the front-panel meter indicates in the BAT CHGD region. The Model 476 can be operated about 12 hours on a fully-charged battery, and the charging cycle is about 16 hours for a complete charge. (Refer to the Model 981-1 literature for complete battery data.) Note that battery charging is accomplished by connecting the Model 476 to an ac line power source and setting the Power switch to ON. When measuring rf power using a battery-equipped Model 476 that is connected to ac line power, the comment in step 2.2.1 above regarding beat notes will be applicable.

2.2.2 Connect the tft power head to the connector on the front panel of the Model 476. Do not connect the tft power head to the source of rf power at this point. (If the power to be measured is not approximately known, use the least sensitive tft power head available, and, after application of rf power as described below, reduce the power range and/or change tft power heads as required.)

2.2.3 Determine the calibration factor from the graph mounted on the tft power head and set the CAL FACTOR control on the Model 476 to the value obtained.

2.2.4 Allow a 15-minute warm-up period, check that the OPR-CAL switch is set to OPR, and in the absence of rf power, zero the Model 476 on any range using its ZERO button.

2.2.5 On any range and in the absence of rf power, set the OPR-CAL switch to CAL and adjust the CAL screwdriver control for the appropriate indication on the front-panel meter scale (at 10 if a coaxial tft power head is in use, and near 8 if a waveguide tft power head is in use). Set the OPR-CAL switch to OPR.

2.2.6 Connect the tft power head to the source of rf power to be measured, adjust the RANGE switch for an on-scale reading, and read the power directly on the meter. The power range to which the unit is set (adjacent to the illuminated scale indicator lamp) determines which meter scale is to be used.

NOTE

If the RANGE switch is set to one of the more sensitive ranges shortly after calibration, it will be noted that the meter will slowly return to zero. This is due to thermal cooling of the tft element. Allow the meter to return to zero before making measurements. Do not re-zero the unit during this interval.

SECTION III

MAINTENANCE

3.1 GENERAL PARTS INFORMATION

Standard readily available components are used in the manufacture of GMC instruments whenever possible. Such parts can usually be obtained from a local dealer. Special or modified parts, as determined by an entry in the last column of the Table of Replaceable Parts, are available from GMC.

When ordering parts from GMC, please indicate your instrument model and serial number, plus the data given in the Table of Replaceable Parts.

3.2 INSTRUMENT REMOVAL

To gain access to the interior of a Model 476, proceed as follows:

3.2.1 Remove the four screws at the rear of the unit which secure the top and bottom covers.

3.2.2 Carefully remove the two covers by sliding them to the rear and then away from the unit.

3.2.3 This will expose the component side of a large printed circuit board which contains all of the internal adjustments referenced in this section. To gain access to the underside of the board for servicing or to remove the board, loosen the two plastic retainers which secure the board. It will now be free to swivel up to expose the underside or be removed from the unit.

3.3 EQUIPMENT REQUIRED FOR TEST AND CALIBRATION

Use the test equipment listed in table 3.1 or equivalents in the performance of the test and calibration procedures.

TABLE 3.1

REQUIRED TEST EQUIPMENT

Description	Mfr.	Model
Oscilloscope	Tektronix	564B/3A9
Electronic Counter	H-P	524D
Digital Multimeter	Fluke	8600A
Variable Autotransformer	Superior Electric	116
Dc Voltage Source	Keithley	260
Ac Power Source	Elgar	201
Cable Assy - See para 3.5.5	-	-

3.4 SPECIAL MAINTENANCE PRECAUTIONS

3.4.1 Do not make resistance checks on input transformer T1.

3.4.2 All circuits use either transistors or integrated circuits. Do not make resistance checks using the lower ohmmeter ranges.

3.4.3 Because of the very low dc voltages involved, repair of the Model 476 must be conducted with special care. Only crimped connections are to be made in the input circuit; if repair becomes necessary, do not solder any of the crimped connections. Use only gold plated copper lugs if replacement of any lugs becomes necessary.

3.5 WARM-UP

3.5.1 Before applying ac power after repair, set the Power switch on the unit under test to OFF, and make continuity tests to insure that neither side of the line cord is connected to the chassis.

3.5.2 Set the 115/230V switch to 115V and the OPR-CAL switch to OPR.

3.5.3 Connect the Variable Autotransformer to a source of 115 volt, 60 Hz power. Connect the unit under test to the Variable Autotransformer and set the line voltage to 115 volts using the Multimeter. (Use the Multimeter when making all line voltage adjustments throughout this section.)

3.5.4 Mechanically zero the front panel meter if required.

3.5.5 Connect the Dc Voltage Source between pins 3 (-) and 1 (+) on the unit under test front-panel connector. To make the connections, it will be necessary to fabricate a cable assembly using a GMC 8376P1 connector to make the connection to the unit under test and a length of three-conductor cable to make the connections to the Dc Voltage Source OUTPUT binding posts and ground. Use only 24/26 AWG copper wire for the connections to pins 3 and 1, and all connections associated with these pins are to be crimped (see para 3.4.3).

3.5.6 Set the unit under test Power switch to ON. Allow a 15-minute warm-up period before proceeding.

3.6 POWER SUPPLY TESTS

Perform the following tests in any convenient sequence.

3.6.1 Adjust the line voltage to 103 volts.

3.6.2 Set the Multimeter for operation as a dc voltmeter on its 20 volt range and connect it between ground and TP1. Verify that the indication on the Multimeter is between +6.76 and +7.83 volts. Note indication.

3.6.3 Connect the Multimeter between ground and TP2 and verify that the Multimeter indicates between -6.76 and -7.83 volts. Note indication.

3.6.4 Connect the Multimeter between TP3 and TP4 and verify that the Multimeter indication is between +11.4 and +12.6 volts. Note indication.

3.6.5 Adjust the line voltage to 127 volts and repeat steps 3.6.2 through 3.6.4. Verify that the three indications do not differ from those recorded above by more than 25, 25 and 150 mV, respectively.

3.6.6 Remove the Multimeter and connect the Oscilloscope between ground and TP1. Verify that the peak-to-peak ripple is less than 4 mV.

3.6.7 Connect the Oscilloscope between ground and TP2, and verify that the peak-to-peak ripple is less than 4 mV.

3.6.8 Connect the Oscilloscope between TP3 and TP4, and verify that the peak-to-peak noise is less than 500 mV. Remove the Oscilloscope.

3.6.9 Disconnect the unit under test from the Variable Autotransformer, adjust the line voltage to 230 volts, set the 115/230V switch to 230V, and connect the unit under test to the Variable Autotransformer. Readjust to 230 volts.

3.6.10 Repeat steps 3.6.2 through 3.6.4 and verify that each of the three indications do not differ from those recorded above by more than 25, 25 and 150 mV, respectively. Remove the Multimeter.

3.6.11 Disconnect the unit under test from the Variable Autotransformer, adjust the line voltage to 115 volts, set the 115/230V switch to 115V, and connect the unit under test to the Variable Autotransformer. Readjust to 115 volts.

3.7 CHOPPER DRIVE ADJUSTMENT

3.7.1 Connect the Electronic Counter using a high-impedance 10X probe between TP5 and ground.

3.7.2 Adjust potentiometer R88 for an indication on the Electronic Counter of 110 ±1 Hz. Remove the Electronic Counter.

3.8 RANGE LAMP CHECKS

3.8.1 On the unit under test front-panel connector, connect pin 5 to pin 6, and verify that the +20 dBm indicator lamp goes on.

3.8.2 Remove the connection between pins 5 and 6 and verify that the +10 dBm indicator lamp goes on.

3.9 FILTER ADJUSTMENT

3.9.1 Set the unit under test to the 10 mW range.

3.9.2 Set S6 within the unit under test to the left (when viewing it from the front of the unit).

3.9.3 Set the Oscilloscope sensitivity to 200 mV/cm and connect it between TP7 and ground.

3.9.4 Apply 13.6 uV to the unit under test using the Dc Voltage Source.

3.9.5 Adjust potentiometer R8 for a symmetrical positive-going full-wave rectified sine wave on the Oscilloscope.

3.9.6 Set the unit under test to the 1 uW range.

3.9.7 Apply 431 nV to the unit under test using the Dc Voltage Source.

3.9.8 Set S6 within the unit under test to the right, zero the unit under test, and set S6 to the left.

NOTE

Unless otherwise indicated, all references to "Zero the unit under test" throughout this section are performed as follows:

1. Set the RANGE switch on the Dc Voltage Source to OFF.
2. Depress and hold the ZERO button on the unit under test for a zero indication on the unit under test front-panel meter.
3. Set the RANGE switch on the Dc Voltage Source to - (minus).

3.9.9 Repeat step 3.9.5 and remove the Oscilloscope.

3.10 DC ZERO ADJUSTMENTS

3.10.1 Set the unit under test to the 10 mW range.

3.10.2 Set the Multimeter for operation as a dc voltmeter on its 200 mV range and connect it between TP6 and ground.

3.10.3 Adjust potentiometer R79 for a zero indication on the Multimeter.

3.10.4 Connect the Multimeter between the OUTPUT binding posts.

3.10.5 Adjust potentiometer R80 for a zero indication on the Multimeter.

3.10.6 Zero the unit under test and do not return the Dc Voltage Source RANGE switch to ⎓. While continuing to depress the ZERO button, adjust potentiometer R96 for a zero indication on the Multimeter. Release the ZERO button, and remove the Multimeter.

3.11 POWER HEAD CALIBRATION CIRCUIT ADJUSTMENT

3.11.1 Set the OPR-CAL switch to CAL.

3.11.2 Connect the Multimeter between TP8 and ground, and set it for operation as an ac voltmeter on its 2 volt range.

3.11.3 Adjust potentiometer R67 for an indication of 895.8 ±0.1 mV.

3.11.4 Set the OPR-CAL switch to OPR and remove the Multimeter.

3.12 RANGE-TO-RANGE ADJUSTMENTS AND ACCURACY TEST

3.12.1 Set the unit under test to the 10 mW range.

3.12.2 Zero the unit under test.

3.12.3 Using the Dc Voltage Source, apply 4.31 mV to the unit under test.

3.12.4 Set the CAL FACTOR control to 100%.

3.12.5 Set the Multimeter for operation as a dc voltmeter on its 2 volt range and connect it between the OUTPUT binding posts.

3.12.6 Adjust CAL screwdriver control for an indication of 1.0V ±1 mV on the Multimeter.

3.12.7 Adjust potentiometer R35 for an indication of 10 on the "10" front-panel meter scale.

3.12.8 Using the Dc Voltage Source, apply 1.36 mV to the unit under test.

3.12.9 Set the unit under test to the 3 mW range.

3.12.10 Adjust potentiometer R38 for an indication of 10 on the "10" front-panel meter scale.

3.12.11 Verify that the Multimeter indicates 316 ±1.6 mV.

3.12.12 Using the Dc Voltage Source, apply 431 uV to the unit under test.

3.12.13 Set the unit under test to the 1 mW range.

3.12.14 Verify that the Multimeter indicates 1000 ±5 mV.

3.12.15 Repeat steps 3.12.12 thru 3.12.14 in accordance with the following tabulation:

Dc Voltage	Range	Multimeter Indication
136 uV	.3 mW	316 ±1.6 mV
43.1 uV	100 uW	1000 ±5 mV
13.6 uV	30 uW	316 ±1.6 mV
4.31 uV	10 uW	1000 ±5 mV
1.36 uV	3 uW	316 ±1.6 mV
431 nV	1 uW*	1000 ±5 mV
136 nV	.3 uW*	316 ±1.6 mV

*NOTE

Due to the presence of noise and drift on these two sensitive ranges,

sequentially zero the unit under test and apply the dc voltages indicated several times, each time noting both the zero and full scale readings on the Multimeter. The indication in the third column of the tabulation is intended to be the average algebraic difference between the two readings.

3.12.16 Set the unit under test to the 10mW range and apply 4.31 mV using the Dc Voltage Source.

3.12.17 Connect pin 5 to pin 6 on the unit under test front-panel connector.

3.12.18 Verify that the Multimeter indicates 930 ±5 mV.

3.12.19 Apply 1.36 mV to the unit under test using the Dc Voltage Source.

3.12.20 Verify that the Multimeter indicates 309 ±2 mV.

3.12.21 Remove the connection between pins 5 and 6 on the front-panel connector.

3.13 NOISE TEST

3.13.1 Set the unit under test to the .3 uW range.

3.13.2 Zero the unit under test.

3.13.3 Apply 43.1 nV to the unit under test using the Dc Voltage Source.

3.13.4 Verify that the noise as seen on the "10" scale of the front-panel meter is less than 1-1/2 small divisions peak-to-peak.

3.14 ZERO CARRYOVER TEST

3.14.1 Set the unit under test to its .3 uW range.

3.14.2 Zero the unit under test.

3.14.3 Sequentially set the unit under test to each of its remaining ranges and verify that its front-panel meter indicates zero at all positions.

3.15 RESPONSE TIME TEST

3.15.1 Connect the Oscilloscope between the OUTPUT binding posts.

3.15.2 Set the Oscilloscope sensitivity and sweep rate to 200 mV/cm and one second/cm, respectively, with storage ON.

3.15.3 Set the unit under test to the 1 uW range.

3.15.4 Set the Dc Voltage Source to apply 431 nV to the unit under test, but do not apply it to the unit under test at this poin

3.15.5 Zero the unit under test, and continue to depress the ZERO button.

3.15.6 Adjust the Oscilloscope trace to be 2.5 graticule lines above the zero graticule reference line.

3.15.7 Release the ZERO button and erase the Oscilloscope trace. At the beginning of the next trace, apply the voltage established in step 3.15.4, and verify that the rise time (10 to 90%) of the waveform is less than 3.3 seconds.

3.15.8 Repeat steps 3.15.3 thru 3.15.7 in accordance with the following tabulation:

Range	Dc Voltage	Rise Time
10 uW	4.31 uV	1.5 sec max
100 uW	43.1 uV	1.5 sec max
1 mW	431 uV	1.5 sec max
10 mW	4.31 mV	1.5 sec max

3.15.9 Remove the Oscilloscope.

3.16 RF BLANKING TEST

3.16.1 Set Multimeter for operation as an ohmmeter and connect it between the RF BLANKING connector at the rear of the unit under test and ground.

3.16.2 Verify that the Multimeter indicates an open circuit.

3.16.3 Depress the unit under test ZERO button and verify that the Multimeter indicates a short circuit. Release the ZERO button.

3.16.4 Set the unit under test OPR-CAL switch to CAL and verify that the Multimeter indicates a short circuit. Remove the Multimeter.

L		DATE	APPROVED
M	REVISED SHEET 1&2 PER ECN'S 4581, 4617 & 4620.	8-20-76 RU	
P	REVISED SHEET 1 PER ECN 4649	9-29-76 RA	
R	ELIMINATED TEMP CONNECTIONS	11/4/76	
S	REVISED IAW ECN 4801, 4743	1-5-77	
T	REVISED SHTS 1&2 IAW ECN 4836	1-26-77	

-7.12V
C36 1000 pf
R5 620K
C6 .01 µf
R11 634K 1/2 W
C8 .47 µf
G1B
TP7
C9 10 µf, 35V.
R18 47K
R13, 10K
+7.12V
C32 .01 µf
C5 .01 µf
R7 3.64K
R8 200
R9 249
R6 475K
R15 47K
R16 47K
R12 10K
R14 4.7K
C7 .47 µf
R17 100K
R102 68K
C31 5.6 µf
R4 16K
C48 33 µf, 10V
R1 100K
C2 1 µf, 35V
Q1 2N4250
C3 .68 µf
C1 .01 µf
R2 249K
C4 68 µf 10V
R3 1 MEGO
R104 3.3K
C33 .01 µf
U1A LM1458
U1B LM1458
U2A LM747
U2B LM747
R20 10.5K
S6
R21 1K
R23 1.11K
R24 10K
C10 4.7 µf, 35V.
U3A LM747
R25 51
TP6
R22 499
R79 10K
R110 1K
R26 2.17
R27 20.94K
R28 209.4K
R29 2.094 MEGO
R40 1K
RANGE
SI-C
SI-D
S2D
CAL
R42 300Ω
R43 100
NOT USED
S3A
ZERO
R47 49.9
R65 200
K2A
K2B
NO
NC
S2C
S2E
S2F
S3C
S3D
S2G
S3E
S3F
K2
CR8 IN4148
R105 100 MEGO
C29 .033 pf
R106 100K
R46 5K
R45 15K
U7A LM747
R96 10K
AUTO ZERO MODULE
R41 680K
R44 680Ω
C35 .01 µf
CR7 IN4148
K1
R108 2.7K
C38 10 pf 35V
Q10 2N3797
C30 .01 µf
C17 .33
R48 200
C34 .001
R49 2K
R50 26.7K
R52 61.9K
R51 49.9Ω
RF BLANKING
R200 27K
CR20 50Ω 2W
R204 430K
Q201 2N4393
R206 200K
R202 82K
R203 160K
CR203 50Ω 2W
R205 100K
CR202 IN4148
U201 IL-74
R201 10K
-7.1V
R32 CAL FACTOR 1K
R33 7.15K
R30 10K
R31 4.12K
R80 10K
C26 47 µf 25V
U8B LM747
R35 3.48K
R25 2.0
R37 9.09
R38 100
R39 287
RECORDER OUTPUT
C41 .01 µf
10 mw
3 mw
1 mw
300 µw
100 µw
30 µw
10 µw
3 µw
1 µw
0.3 µw
R103 28.7K
S5
BT1+
Q5 2N2222
R36 15K
Q4 2N2222
Q3 2N2222
R84 1.3K
R85 1.5K
R82 100K
R87 100K
R83 100K
R86 100K
CR5 IN4148
R77 4.7K
+20 dBm
PASSIVE LOGIC
CR8 IN4148
OPR
CAL
ZERO
NOT USED

GENERAL MICROWAVE CORPORATION FARMINGDALE, N.Y.

SCHEMATIC
MODEL 476 POWER METER

SIZE D | CAGE IDENT NO. 11839 | 8274

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
—	A	REVISED PER ECN 4581 & 4620.	8-20-76	RM
	B	RELOCATED TERM. CONNECTIONS	11/4/76	RM
	C	REVISED IAW ECN 4836	1/26/77	RM

CAL OSC

+7.12V
R68 1K
R69 10K
VR1 1N825A
R71 10K
R72 4.99K
-7.12V
R70 4.99K
U4A LM1458
CAL REF
R67 100K
R66 348K
R63 20K
R61 20K
R62 20K
C19, 150 pf
C18 10 pf
CR2 1N4148
U6 LM301A
R64 10K
CR3 1N4148
R60 100K
R58 49.9K
C14 10 µf
U4B LM1458
R59 24.9K
CR1 1N4148
Q2 2N4393
R53 100K
R54 18K
R56 15.8K ±1%
C12 1000 pf
C44 10 pf
R55 39K
C25 150pf
C13 68 pf
U5 LM301A
C11 1000 pf
R57 15.8K ±1%
C16 1µf
C15 1µf
0.8957 VRMS
TP8

PWR SUPPLY

T2
AC
C42
C43
BRN
230V
115V
RED
S4
ORN
S5 4 F1 YEL
0.1A SLO-BLO
S5-7
GRN
BLU
BLK
A1
BT1 24V
CR9 1002
R73 10 2W
C20 500 µf
CR6
C40 1µf 35V
C39 1µf 35V
R109 180 1W
U10 F78L12AHC
R100 10K 1%
R101 10K 1%
U9
R78 100
C21 .01 µf
U8 RC4194D
R74 7.15K
C22 .001 µf
R75 17.8K
C23 10 µf
C24 10 µf
+7.12 V
-7.12 V
TP1
TP2
TP3
TP4
C37 10µf 25V DC

CHOPPER DRIVER

R88 100Ω
Q8 2N2907
Q9 2N2907
R90 2.32K
R89 S.A.T.
C27 2.2 µf
C28 2.2 µf
G1 COIL
TP5
TP9
Q6 2N2222
Q7 2N2222
R91 4.7K
R92 4.7K
R93 4.7K
R94 27
R95 4.7K

		CONTRACT NO	
		DRAWN F. FUOCO	5-21-75
		CHECKED S. BYRNE	6-11-74
		APPROVED	
MODEL 476 APPLICATION			

GENERAL MICROWAVE CORPORATION FARMINGDALE, N.Y.

SCHEMATIC

MODEL 476 POWER METER

SIZE	CODE IDENT NO	
D	11332	8274

SCALE — SHEET 2 OF 2

MP MASTER
MA31479